Society for Scientific Values

Ethics in Scientific Research Development and Management

News And Views

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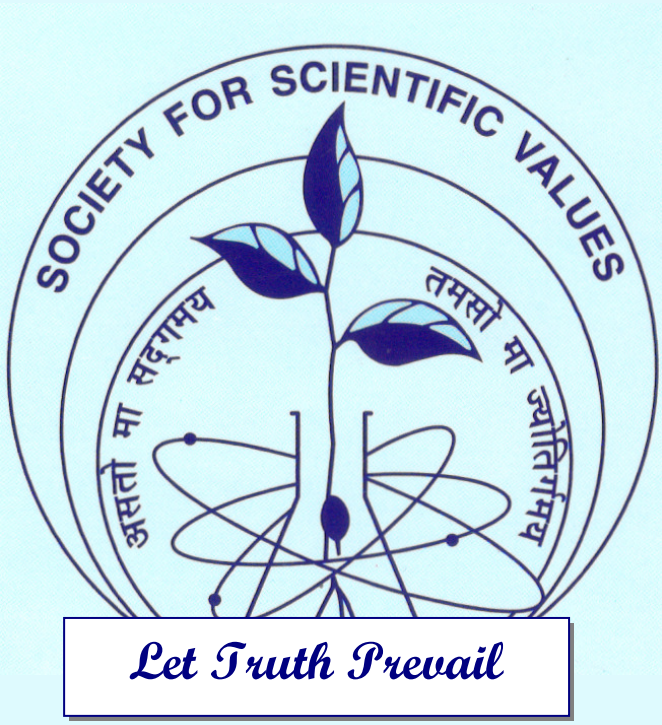
Special Issue on Scientific Ethics – Values & Conduct



Regd. Office: DST Centre for Visceral Mechanisms
V. P. Chest Institute
University of Delhi, Delhi

Editorial Board

Main objectives of the 'Society for Scientific Values'

1. To promote objectivity, integrity and ethical values in pursuit of scientific research, education and management, and
2. To discourage the unethical acts in these areas

Website : scientificvalues.org

Executive Council of SSV
(August1, 2008 – July 31, 2011)

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Special Invitee

Dr. P.N. Tiwari (Founder Member SSV, Former Director NRI, IARI)
Dr. Santa Chawla (Editor News & Views, Scientist, NPL)
Dr. J. C. Sharma (Scientist, NPL)
Dr. S. N. Singh (NPL New Delhi)
Dr. Vijay Kumar (ICMR, New Delhi)
Dr. Rakesh Singh (PWC, Patna)

Membership of the Society for Scientific Values

Scientists who wish to join the efforts of the Society to promote ethics (support right and oppose wrong) in scientific research, development and management and, who meet the following requirements are welcome to become the member of the society.

1. He/she should have allowed his name to apppear as an author in only those publications in which he/she was actively involved, in data collection, theoretical formulation, design and construction of apparatus, field trips, mathematical derivation and calculations, statistical analysis and interpretation of results, as distinct from administrative support and providing funds or facilities.

2. He/she should have never plagiarized or made false claims or indulged in or supported and encouraged any kind of unethical activity in science.

3. He/she should agree to withdraw from the Society if he/she ceases to adhere to the requirements 1 and 2 above.

A scientist who wishes to become member should send his brief biodata to the President or Secretary of the Society. A member of the Society may also send biodata of such scientist for the membership. Non-scientists who have promoted ethics in their profession can also become member of the Society.

Contents

Editorial

Progress of a country is intricately interlinked to advancement in Science & Technology and self reliance in production. Innovative and knowledgeable scientists and engineers constitute formidable manpower strength in this regard. Educating Scientists and Engineers in ethical values is a very important part in their training process. Because following ethical practices do not only advance the scientific knowledge and their applications but also place them in an impeccable pedestal of integrity, trust, respect and enhance the reputation of the country as a whole. The fact that defying norms of scientific ethics and honesty though may bring short term personal gain, but in the long run may ruin their carrier and bring shame to the individual, organization and the country, has to be driven into the minds of young researchers.

The special issue of News & Views on ***Scientific Ethics – Values & Conduct*** is brought towards fulfilling this goal. Senior members of the Society for Scientific Values are putting their endeavor in formulating course materials to make the researchers aware of the different aspects of scientific misconduct and the shameful results that such practices can bring. We hope this special issue will serve as a guide to many in the scientific field.

Santa Chawla

Honours and Awards to SSV Members

Indian Institute of Technology , Delhi conferred on Prof. K.L. Chopra "Freedom Of The Institute" Award on its Foundation Day, Jan27,2011.

Dr. Vikram Kumar has been honoured with "ISA Technovation Awards 2011 in the TechnoMentor category" by India Semiconductor Association on February 21, 2011

SSV activity highlights in the current period

In the last AGM of SSV, a committee was formed to prepare course lecture/reading material on Ethical Issues- Values & Conduct. This Committee is expected to prepare a set of lecture notes for inculcating scientific values in science students, research scholars, scientific workers and administrators.

The committee consists of the following members:

(1) Dr. Indira Nath (Bioethics)- Coordinator
(2) Dr. Raghu Ram (Bioethics)
(3) Dr. Indramani (Agriculture)
(4) Dr. S. Satyanarayana of ICMR
(5) Dr. Sujeet Choudhary, IIT Delhi.
(6) Prof. Bikash Raymahashay (Environmental Ethics)
(7) Dr. P. N. Tiwari- Convener

SSV welcomed the proposal to collaborate with AISSQ to conduct a Session on Ethical Values in S&T in the International Conference on Science & Spirituality being organized by AISSQ on March 12-14, 2011 at Delhi Technological University, Delhi.

New SSV Members

The following nominations have been approved for SSV membership;

(1) Prof. Kalluri Subba Rao, INSA-Senior Scientist, JNTU, Hyderabad-500085.
(2) Dr. Sunil Morekar, Eye Surgeon, Hinduja Hospital, Mumbai.
(3) Dr. Jugal Kishore Mishra, Escort Hospital.
(4) Prof. Subhash C. Mishra, IIT Guwahati.
(5) Dr. O. S. Panwar, National Physical Laboratory.
(6) Dr. V. M. Katoch, DG-ICMR.
(7) Dr. Ajay Sharma, Education Dept.Shimla.
(8) Dr. Mahesh Gupta, NIT Kurukshetra.
(9) Dr. Balakrishnan, K.S. Rangasamy College of Tech. Tamilnadu.
(10) Dr J Philip Robinson, K.S. Rangasamy College of Tech. Tamilnadu.

Some cases of scientific misconduct

1. Prof. Kalyan Kumar, who earlier remained suspended for over three years from his position of director, NERIST, for charges of plagiarism, has been appointed by MHRD, GoI, in Feb /Mar 2010 as director of the upcoming central technical institute Ghani Khan Choudhury Institute of Engineering and Technology, (GKCIET) in Malda, West Benagal.- under the mentorship of NIT, Durgapur, WB.
2. Director, IIT Jodhpur has withdrawn the appointment offer to an Assistant Professor who has plagiarized some research papers. This case was brought to the attention of the Director, IIT Jodhpur by the President, SSV.

3. Two International journals have withdrawn research papers of faculty members of IIT, Kanpur and one paper authored jointly by the faculty members of IIT Delhi, Nuclear Science Centre and Jamia Millia on grounds of plagiarism. SSV has written to Director, IIT Kanpur on the issue.

Retraction notice to "Microbial production of dihydroxyacetone" [Biotech Adv. 26 (2008)
Page 938
Ruchi Mishra, Seema Rani Jain, Ashok Kumar
Show preview | Purchase PDF (86 K) | Related articles | Related reference work articles

Retraction notice to Molecular imprinting in solgel matrix Biotech Adv. 26 (2008)
Page 939
Radha Gupta, Ashok Kumar
Show preview | Purchase PDF (88 K) | Related articles | Related reference work articles

Retraction notice to Nanosilver The burgeoning therapeutic molecule and its green synthesis Biotech Adv. 27 (2009)
Page 940
Ramanathan Vaidyanathan, Kalimuthu Kalishwaralal, Shubaash Gopalram, Sangiliyandi Gurunathan
Show preview | Purchase PDF (91 K) | Related articles | Related reference work

(http://www.sciencedirect.com/science/journal/07349750)

The third retracted paper as above is form Department of Biotechnology, Division of Molecular and Cellular Biology, Kalasalingam University, Anand Nagar, Krishnankoil-626190, Tamilnadu, India. The reason cited by Elsevier was "This article has been retracted at the request of the editor as the authors have plagiarised part of several papers that had already appeared in several journals."

New cases under consideration with SSV

1. The plagiarisation case of Prof. M. Chakraborty of IIT Kharagpur who has published a paper from his student's PhD thesis without giving due credit to the student.

2. The M.Tech thesis of Pankaj Chandna in Kurushetra Univ/NIT,(KU) is a verbatim copy of the thesis of Yogesh Saxena submitted in IIT Delhi. Despite a complaint, no action has been taken by the KU authorities so far. SSV will conduct further investigation of this case.

1. Several complaints have been received from the BHU faculty regarding the appointment of faculty members by the VC of BHU on various committees on the basis of the caste of the individuals. SSV deplores the caste being the basis of any selection, particularly in prestigious and central institutions. However, it was felt that such caste-influenced matters being invariably complex, SSV should not get involved in such issues.

2. The MNIT Allahabad Director is requested once again to inquire into the case of plagiarism by Dr. Manoj Kumar of Mathematics Department and take suitable disciplinary action.

News pertinent to SSV's cause

Global

Integrity policy by US

"White House Unveils Integrity Policy to Keep Politics out of Science" [Nature, December 20, 2010 10 By Eugenie Samuel Reich]

On 17 December, John Holdren, director of the White House Office of Science and Technology Policy, released a set of guidelines for scientific integrity in US government departments and agencies indicating "a clear prohibition on political interference in scientific processes and expanded assurances of transparency". President Barack Obama's memorandum on scientific integrity that forbade the distortion of science for political ends has lead to the guidelines. The document covers direction to "ensure that the data and research used to support policy decisions undergo independent peer review", to adopt protection for whistleblowers and to "facilitate the free flow of scientific and technological information".

Retraction and Plagiarism policing

"Retractions in the scientific literature: is the incidence of research fraud increasing?" [*J Med Ethics* published online December 24, 2010 by R Grant Steen]

Incidences of retraction of scientific papers have considerably increased for many reasons including fraud (data fabrication or falsification) or error (plagiarism, scientific mistake, ethical problems). The evaluation of various reasons behind retraction of 742 English language research papers from the PubMed database between 2000 and 2010 indicated that mainly fraud or error are the reasons for retraction. Out of 742 papers, 111 were retracted for Fabrication, 98 for Falsification, 234 for scientific mistake, 117 for duplicate submission, 107 for Plagiarism, 76 for Ethical violation, 61 for unstated reasons and 27 for Journal errors. Out of total eight reasons for retraction, most common reason is scientific mistake. In general, error is more common than fraud, but fabrication and data plagiarism are more common than text plagiarism

In 2010, the journal Nature has published four retractions, whereas it was only one in 2009. In the past decade, the retraction by Nature was about two per year, compared with about one per year in the 1990s except for the mass retractions of papers co-authored by Schön. *Times Higher Education* commissioned a survey by Thomson Reuters that counted 95 retractions among 1.4 million papers published in 2008.

Journals have subsequently been alerted and started plagiarism policing with the help of software CrossCheck, a plagiarism checking service launched in June 2008 by CrossRef, a non-profit collaboration of 3,108 commercial and learned society publishers. The service uses the iThenticate plagiarism

software produced by iParadigms, a company in Oakland, California. It has the database of full-text articles, against which other articles can be compared. Publishers subscribing to CrossCheck must agree to share their own databases of manuscripts with it. So far, 83 publishers have joined the database, which has grown to include 25.5 million articles from 48,517 journals and books. [Source Nature Vol 466, 8 July 2010]

Scientific Sabotage by Indian Student in US laboratory
[Source: Nature, Vol. 467, 30 September 2010 by Brendan Maher]

Vipul Bhrigu,a former postdoc at the university of MIchigan's Comprehensive Cancer Center, allegedly sabotaged the work of Heather Ames, a graduate student in his lab, by tampering with her experiments and poisoning her cell-culture media over the course of several months. Captured on hidden camera in the laboratory, Bhrigu confessed to university police and pleaded guilty to malicious destruction of personal property. Due to the persuasion of Ames and her supervisor, Theo Ross, administrators at the University of Michigan worked with police in Bhrigu's case. Federal bodies in US , that provide research funding have limited ability and inclination to take action in sabotage cases because they aren't interpreted as fitting the federal definition of research misconduct, which is limited to plagiarism, fabrication and falsification of research data. Bhrigu went to US from India in 2003 for doing his PhD at the University of Toledo, Ohio, under cancer biologist James Trempe who describes Bhrigu as an average student. According to Bhrigu, jealousy of others moving ahead was the reason for such action. Bhrigu was ordered to pay around US$8,800 for reagents and experimental materials, plus $600 in court fees and fines — and to serve six months' probation, perform 40 hours of community service and undergo a psychiatric evaluation. In addition, Bhrigu's entire salary, half of Ames's, six months' salary for a technician to help Ames get back up to speed, and a quarter of the lab's reagents, the court arrived at a possible figure of $72,000, with the final amount to be decided upon in September. However, Bhrigu and his wife left the country for India on visa grounds . Now that Bhrigu is in India, there is little to prevent him from getting back into science. And even if he were in the United States, there wouldn't be much to stop him under present law.

A shocking discovery
[Source**:** Nature, Vol. 467, 7 October 2010]

Susan Reverby, a historian and professor of women's and gender studies at Wellesley College near Boston in Massachusetts is an authority on the

notorious Tuskegee experiments, during which treatment was withheld from more than 600 African American men with syphilis. Her recent discovery that the US Public Health Service exposed several hundred Guatemalans to the disease in an undocumented research project in 1946–48 led to an official apology from the United States to the Guatemalan government and the promise of a full investigation.

National

'A Blank Page in the History of Biotechnology Filled'

The unearthing of unpublished research papers by late Dr. Yellapragada SubbaRow has raised the question "Was the birth of Biotechnology delayed because Dr SubbaRow, of tetracycline antibiotics fame, could not publish his Harvard research at the turn of 1930s?

Nobel Laureate George H Hitchings told in 1965 that his Harvard colleague isolated in that period several phosphorus compounds that were in all probability nucleotides involved in the synthesis of RNA and that these had to be rediscovered years later by other workers because SubbaRow was not allowed to publish them. Dr Mahlon Hoagland (1921-2009) is presently credited with building the foundation of genetics by discovering in the 1950s and 1960s the transfer RNA and the mechanisms behind amino acid activation. SubbaRow did the research under the supervision of Dr Cyrus H Fiske, his co-discoverer of phosphocreatine and ATP. Dr Fiske underwent a personality change after the duo did not get due recognition for unravelling the energy molecules and would not permit the publication of their joint work.

These unpublished papers are available on Doctor Yellapragada SubbaRow Archives Online a sub site of the six-year-old www.ysubbarow.info and can be accessed through the following link: http://www.ysubbarow.info/Archive/scientist.php?sid=2. The six papers on the phosphorus compounds of liver, pancreas, spleen and kidneys can be accessed also by visiting www.ysubbarow.info and clicking the blinking tab YELLAPRAGADA SUBBAROW ARCHIVES ONLINE in the HOME page and proceeding to Scientific Works>Unpublished.

Editor of Elsevier Journal rights to Indian Minister

On 22nd October 2010, Purnendu K. Dasgupta, Editor, Analytica Chimica Acta and Jenkins Garrett Professor at The University of Texas at Arlington

[http://www.uta.edu/chemistry/faculty/directory/Dasgupta.php] wrote to Sri Jairam Ramesh, Honorable Minister for Environment & Forests, Government of India, seeking help on a serious matter of plagiarism by a group of authors from Department of Pharmacy in Sumandeep Vidyapeeth in India. These authors are allegedly publishing articles mostly in Indian journal after plagiarizing other people's published articles. The Editor's appeal to the head of the Department and to the journal publisher was not replied. The Editor, being Indian, was concerned that such "total lack of integrity is going to undermine all the gains the country has made unless swift and fast action is taken."

Some examples of their plagiarized articles are appended below:

Biomarker detection with the help of proteomic approaches by Pratik Mehta, Keyur Patel, Ujjwal Sahoo, A.K. Sen, Dhanya B and Sachinandan Basak, published in the International
Journal of ChemTech Research 2, (2010) 1933-1938 is copied from *Proteomic appoaches to*
biomarker detection by Ming Zhou, Thomas P. Conrads and Timothy D. Veenstra, in Briefings in Functional Genomics and Proteomics 4 (2005) 69-75.

Outline on the technical aspects mass spectrometry of RNA: connecting the genome toward
the proteome by Pratik Mehta, Keyur Patel, Ujjwal Sahoo, A. K.Sen and Dhanya B. published in Pharma Science Monitor, 1, (2010) 318-333 is copied from Zhaojing Meng and
Patrick A. Limbach, Briefings in Functional Genomics and Proteomics 5 (2006) 87-95.
Note that the Editor-in-chief of the Journal is the head of the Department of Pharmacy in Sumandeep Vidyapeeth where the authors list their affiliation.

Latest development in hplc techniques for proteomics by Keyur Patel, Pratik Mehta, Ujjwal
Sahoo, A. K.Sen and Dhanya B published in International Journal of Pharma World Research, 1(2010) issue 2,
http://ijpwr.com/PAST_files/pdf%20vol%201%20issue2/HPLCReview_Article_k1%206630.pdf is copied from Goran Mitulovic and Karl Mechtler,
Briefings in Functional Genomics and Proteomics 5 (2006) 249-260.

Single Drop Micro Extraction and Future Trends by Keyur Patel, Pratik Mehta, Ujjwal Sahoo, A. K.Sen and Dhanya B. A. published in International Journal of ChemTech Research
2 (2010) 1638-1652 is copied from Michael A. Jeannot, Andrzej Przyjazny, John M. Kokosa
Journal of Chromatography A, 1217 (2010) 2326–2336

Case of Prof. Karmeshu with IEEE

[Reported in December, 2008 issue of News & Views]

> 'In January 2008, Prof. Karmeshu a former EC member of SSV and a Bhatnagar award winning scientist from the School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi, reported the case of suspected plagiarism of his research paper by Prof. Kouvatsos and Assi from the Department of Computing, School of Informatics, University of Bradford. Against complaint from Prof Karmeshu, IEEE has allowed the plagiarised paper to remain and only banned Kouvatsos from publishing in any if the IEEE publications for a period of 1 year. Prof. Karmeshu has represented to the IEEE against this decision, as it did not offer any relief to him and his paper continues to remain unpublished. SSV appeals to the IEEE management to re-examine the whole case properly and seriously consider withdrawing the plagiarized manuscript and avoid allegations of celebrity justice.'

Prof. Karmeshu and Dr Shachi Sharma have finally won the first battle with IEEE as IEEE has finally notified that Kouvatsous and Assi have plagiarized their work. It implies that Prof. Karmeshu now should be able to publish their paper in a suitable journal. Ideally, IEEE should have withdrawn the plagiarized paper, but that is a battle they still may continue to fight. The proceedings took very long to get the results and the story did not get the attention it deserved compared to reverse cases when withdrawal of many dozens of papers by Indian authors on similar grounds have taken place.

Seminar/ courses in Ethics

International Conference & Courses on Bioethics, Singapore, May 23-30, 2011

'The Conference and the Courses are designed to offer a PLATFORM for the exchange of information and knowledge and to hold discussions, lectures, workshops, courses and exhibition of programs and databases.

Target Groups

Teachers and educators in medical schools, nursing schools, law schools, schools of social work, faculties of philosophy and ethics

- Professional Organizations
- Governmental & Public bodies

The Main Conference and Seminars Topics:

Bioethics Education: General, Objectives, Methodology

- Level of Teaching, Status of the Programs, Evaluation of Students
- Study resources, References & Materials
- Bioethics at large: Past, Present, Future
- Bioethics at large: Cultural, Social & Legal Aspects
- Bioethics at large: Ethical & Philosophical Concepts and Schools

The Conference and the Courses are organized by the Indonesia Health Law Society and the UNESCO Chair in Bioethics (Haifa).

Abstracts of approximately 250 words are invited for oral and poster presentations.

The deadline for abstract submission: **20 April 2011'**

For additional information:

www.bioethicsconference2011.com

The Division of Ethics of Science and Technology

Sector for Social and Human Sciences

UNESCO

Ethics Teacher Training Course at Duquesne University , Pittsburgh PA , U.S.A. (20-24 June, 2011)

'Ethics education is increasingly recognized as an important need for future scientists and health professionals. Training opportunities and facilities for teaching ethics, however, are limited and not widely available. This course at Duquesne University , Pittsburgh , provides unique opportunities for enhancing educational capacities in ethics education. It offers a high-level master class with the cooperation of experienced ethics teachers.

Experiences with existing teaching programs in the area of ethics are publicly available through the Ethics Education Program of UNESCO (www.unesco.org/shs/ethics/geobs). Experiences concerning the contents, intensity, methods and materials of existing programs in many countries therefore can be exchanged among experts. The quality of ethics education, however, also substantially depends on the quality of the teachers. Ethics teaching can be made much more

influential and attractive for students if they are engaged by highly qualified, stimulating and inspiring teachers.

This course is set up to provide training to ethics teachers with the purpose to enhance their skills and abilities. It aims particularly on training a new generation of teachers so that ethics teaching programs in the near future can expand and improve in all Member States of UNESCO. The course is organized by the Center for Healthcare Ethics at Duquesne University in Pittsburgh, USA (Professors Henk ten Have and Gerry Magill), in cooperation with the UNESCO Chair in Bioethics, University of Haifa, Israel (Professors Amnon Carmi and Daniella Keidar).

Participants should have a Masters degree (in areas such as law, medicine, philosophy, ethics, or social sciences), hold a University faculty appointment to teach courses, and have good command of English language. Persons who want to register should submit a registration form to Dr. ten Have at tenhaveh@duq.edu. This form is available at http://www.duq.edu/healthcare-ethics/summer-school-2011.cfm. Applicants should also include a letter of intent (2 pages) explaining why they wish to participate in the course and how they expect to benefit from participating. Cost is $800, which includes meals. Students who wish to obtain accommodations for their stay may do so with at an additional cost of $100 for their entire stay.

For more information: Please call The Center for Healthcare Ethics at Duquesne University at (001) 412-396-4504; or visit the website http://www.duq.edu/healthcare-ethics/

Deadline for registration: March 1, 2011. ’

The Division of Ethics of Science and Technology

Sector for Social and Human Sciences

UNESCO

Some concern

Since donations to SSV have now been exempted from income tax under 80G by the IT department, appeal is made to SSV members and fellow supporters for generous donations to strengthen our corpus fund to attain financial autonomy.

Compiled by
Santa Chawla

Basis and General Principles of Ethics for Science

P.N. Tiwari
Former Project Director NRL , IARI, New Delhi and one of the founders of SSV

Science is Different from Other Activities.

There are different kinds of persons in a society engaged in different kinds of activities, like politics and politicians, business and businessmen, law and lawyers, science and scientists. Politicians seek power by all means. Businessmen seek maximum profit not necessarily by fair means. A lawyer seeks to win his case irrespective of its truthfulness by interpreting law in its favour. What does scientist seeks? He seeks truth and only truth of the nature and its phenomena. Because of this all these activities except science can survive even if deceit and falsehood are a part of them. In case of science, the outcome of scientific research becomes misleading damaging the growth of science if it contains an element of deceit and falsehood either in setting up of experiment or acquiring data at any stage of experiment. Science is therefore very much different from other activities. Science is based on truth, the guiding principle through and through. What are the other values that are essential for the practice of science?

Basis of Ethics for Science

Ethics for a profession is the moral principle based on which the activities of that profession are conducted. While developing the ethics for science which derives directly from its own activities, Jacob Bronowski at first thought that this study could lead only to a set of technical rules; elementary rules for using test rules, or sophisticated rules for inductive reasoning. But his enquiry turned out to be quite otherwise. “There are, oddly, no technical rules for success in science. There are no rules even for using test rule which the brilliant experimenter does not flout: and alas, there are no rules at all for making successful general inductions. This is not where the study of scientific practice leads us. Instead, the conditions for practice of science are found to be of another and an unexpected kind. Independence and originally dissent, freedom, and tolerance; such are the first needs of science; and these are values which, of itself, it demands and forms” (1).
“The values of science derive neither from the virtues of its member, nor from the finger-wagging codes of conduct by which other professions remind them

to be good. They have grown out of the practices of science, because they are inescapable conditions for practice of science" (1).
Science is search of truth. If truth is to be found and tested in action, what conditions grow from this? First is independence in observation and thinking. Second is originality. A person must see, do, and think for himself. Then comes dissent, one should have the freedom to disagree with the other persons' view and express it. Every scientist has to learn the 'hard lesson' to respect the views of the next man even when the next man is tactless enough to express it (1).
"Science confronts the work of one person with that of another, and grafts each on each, and it cannot survive without justice and honour, and respect between man to man. Only by these values science can pursue its steadfast object to explore truth"(1).

A scientist has to be totally objective and open in thought while formulating a theory or planning experiments. He has to be fully honest in his speech while speaking about his work; and completely honest in action while performing experiments and publishing the results. One may say that this is an ideal, and most of the ideals are not fully practiced. This might be true in other professions but it is certainly not true in science, because science will not progress even an inch if the scientists are not fully honest in their thought, speech and action in doing science.

Thus the values of science called ethics for science or scientific values are truth, honesty, trust, independence, originality, dissent, respect, tolerance, fairness, openness, objectivity, and justice. One may say that all these are human values that apply in everyday life of any good society. True, it is very good for the progress of science, if these values are the prevailing societal values. But when there is a conflict or contradiction between the values generally held in a society and those rooted in science, then scientists' choice would be for the latter, even if he has to struggle and suffer loss. These have to be born with fortitude for the progress of science (2). Such scientists deserve honour and full support.

Obligations of Researchers

Scientific research is based on the foundation of trust. No one can verify all the results of other scientists which he uses in his own work. Researchers trust that their colleagues have gathered data carefully, have used appropriate analytical and statistical techniques, have reported their

work accurately and have given the importance to the work of other researchers in their field.

The researchers have three sets of obligations (3) that direct their adherence to scientific values and ethics. “First, researchers have an obligation to honour the trust that their colleagues place in them. Science is a cumulative enterprise in which new research builds on previous results. If the research results are inaccurate, others waste their time and resources trying to replicate or extent those results. Dishonest action in an area can impede the entire field of research or send it in a wrong direction, and progress in that field may slow.”

Second, researchers have obligations to themselves. Violation of scientific values and ethics in research can make it impossible to achieve a goal, whether the goal is earning a degree or post doctoral fellowship and maintaining a reputation as a productive and honest researcher. Adherence to ethics and norms of science builds personal integrity in a research career.

Third, because scientific results influence society, researchers have an obligation to act in ways that serve the public. Some scientific results directly affect the health and well-being of individuals, as in the case of clinical trials or toxicological studies. And even when scientific results have no immediate application- as when research reveals new information about the universe such as the universe in which we live did not exist before 13.7 billion years ago, it speaks to our sense of wonder and pave the way for further research.

Researchers generally keep all these obligations in mind towards other researchers, towards oneself, and towards society in doing research and reporting the results. However, those who may be tempted to ignore these obligations must know that their action causes harm not only to science and society, but it causes much greater harm to their own career and reputation. That is why advising by more experienced scientists is essential when beginning researchers are learning these obligations (3).

Research Misconduct

Any violation of scientific values and ethics like deceit and falsehood in research is called scientific misconduct. Anyone who does it is putting his or her scientific career at risk and is harming the overall interest of science and its use of society.

A statement developed by US office of Science and Technology Policy defines misconduct as fabrication or falsification or plagiarism in proposing, performing or reviewing research or reporting research results. According to

the statement, the three main elements of misconduct are defined as follows (3):

1. Fabrication is making up data or results.
2. Falsification is manipulating research results, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in research record.
3. Plagiarism is the appropriation of another person's idea, process, results or words without giving appropriate credit.

In addition (a) abuse of confidentiality in peer review, (b) failure to allocate credit appropriately in scientific publication, (c) not observing regulations governing research, (d) failure to report misconduct and (e) retaliation against individual who reports misconduct are also included in the scientific misconduct. Other behaviours that seriously derivate from commonly accepted research practices may also be included in the possible scientific misconduct (3).

When researchers intentionally deceive their colleagues by falsifying information, fabrication of research results or using other's words and ideas without giving credit, they are violating basic values on which science is based. These actions are seen as the worst violation of scientific values and ethics. Such actions should be treated very harshly. A healthy scientific community treats them as such. Some such persons have been jailed in USA (4).

Responding to Violation of Scientific Values and Ethics

Science is largely a self regulating enterprise. Scientific community is the source of the standards and practices to which researchers are expected to adhere. Self regulation ensures that the decisions about professional conduct are made by experienced and qualified peers. But for self regulation to work a researcher must be willing to inform others when they see that a colleague is violating scientific values and disciplinary practices (3).

But this has to be done carefully. Reprisals by accused and his supporters have occurred in the past. In USA, law prevents institutions and individuals from retaliating against those who report concerns in good faith (3). In India, Society for Scientific Values (SSV) has been trying to do the same. Allegations about violations of Scientific Values and Ethics can have serious consequences for all parties concerned. It should be done with care and responsibility.

Concern, at first, can be best raised in the form of questions rather than allegations. It is important to remain objective, fair, and unemotional in doing so. Another possibility is to discuss the situation with a good friend, trusted advisor and peers. Sometimes the broad outlines of the case can be discussed without revealing the names (3).

Despite possible difficulties, someone who has witnessed or witnessing a colleague in research misconduct has an unmistakable obligation to act. Research misconduct, especially, falsification, fabrication, and plagiarism has the potential to weaken the integrity of science and forfeit the potential benefit of research to the society. **"The scientific community, society, and personal integrity of individuals, all emerge stronger from effort to uphold fundamental values on which science is based" (3).**

While inaugurating the seminar on "Scientific Misconduct and Disciplinary Action", organised by the Society for Scientific Values in 1995, late Sri T.N. Seshon, Chief Election Commissioner of India, who made major reforms in the election process said:

"If the scientific community will not enable the country to recognize conduct and misconduct, and put it down with firmness after due process and impartiality, who else can do it? If there is one group which because of training and adherence to truth can probably bring back character to the country, it is the scientists. Character cannot be built by anything else than the primary adherence to truth. Truth is the fundamental basis of science. Any scientist who departs from truth is guilty of grievous misconduct. Please set an example for the rest of the country" (5).

This is what the Society for Scientific Values (Website; www.scientificvalues.org) has been trying to do since its formation is 1986. Most of the scientists, especially on high positions in India, know that someone is watching and will question any violation of scientific values and ethics in research. The Society has been investigating into the allegations of scientific misconduct (misconduct in research and publication) and sending its findings to the concerned organisation for taking appropriate action if the allegation is found true.

The Society, at present, has taken up a program of preparing materials of a series of lectures for the education of young researchers and PhD students in the ethics of scientific research. **This article may constitute the material for the first lecture of the series in the Indian condition.**

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Plagiarism--A Serious Misconduct

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High levels of ethics and moral values have been integral part of Indian social and personal life since ages. Our social structure, both in villages and cities, had inbuilt system of correcting wrong thoughts and actions. The rituals both in social and school life were designed to inculcate moral values in young minds. Gurukul system of education was meant for imparting value based education to students belonging to different strata of society at one platform. Indian epics, Ramayana and Mahabharata and spiritual scriptures, Upanishads, Gita, Guru Granth Sahib and Koran are full of ethical and moral teachings. In fact, even at present India is considered spiritual Guru in the world. This is because of the facts that to be truly spiritual one has to speak and act as per truth at all costs, to love all as oneself, to be objective and dispassionate and, to be pure in thoughts, words and deeds. There are still many people with these attributes in the spiritual stream in our country. It may sound somewhat strange but it is true, most of the attributes that are essential to become a truly spiritual person are also essential to become truly good scientist. Einstein and many other scientists who have made major discoveries and inventions had all these attributes. In fact without these attributes one cannot become true scientist because science is search of truth without any kind of bias.

`There has been sharp decline, at present, in the ethical and moral values of people in general in our country. Unfortunately, the profession of science is no exception. Some scientists argue that if other professions are infested with immoral and unethical acts how can science and scientists remain untouched by this menace. But such people forget that science is search of truth and truth cannot be found by untruth means. The basic pre-requisite for becoming a true scientist is that he/she must be truthful in thought, speech and action, and possess overall very good character. Lack of these qualities among our many scientists and managers of science and technology is one of the main reasons for poor quality of scientific and technological contributions in India despite its very large scientific and technical man power and infrastructure. There is an urgent need to improve the situation both by disciplinary action and education for improving the

quality of research and development in the country. The "Society for Scientific Values" has taken up both the work. It enquires into allegation of misconduct in scientific research, development and publication, and sends its findings for taking appropriate disciplinary action to concerned organizations, if the allegations are found true.

There are cases of intentional and pre-meditated unethical acts. Such acts should be dealt with by disciplinary means. However, wrong acts may be committed by PhD students and young scientists due to their ignorance of what constitutes misconduct in scientific research, development and publication. The "Society for Scientific Values" (SSV) has prepared lectures material for imparting education especially to them about ethics and norms of research, development and publication. These materials are proposed to be used by members of SSV and other interested persons to educate the budding young scientists through lectures and discussions. There are three main types of misconduct in scientific research and publications. These are plagiarism, fabrication and falsification. This article deals with plagiarism. All three types of misconducts are considered as worst violation of ethics of science because they undermine the trust on which science is based. They seriously vitiate scientific writings.

An Ethical Scientific Writing

The outcome of all research projects and programmes is reported in one or other form of scientific writing. It may be in form of research paper, book, monogram, scientific bulletins, popular scientific articles, research reports and scientific writing for children. To begin with, we must understand the features of a good scientific writing. "A good scientific writing may be characterized by clear expression, conciseness, accuracy and honesty." (1). It should be reported with simplicity, clarity, without ambiguity and in unequivocal terms. In fact, scientific writings are the main performance parameter of a scientist or team of scientist for purpose of evaluation, monitoring and promotion. It is treated as wealth of a scientist because his career advancement depends on it. In the present era of cutthroat competition it has gained more importance. That is why every care should be taken to ensure that one's scientific writings are good and free from any type of misconduct. Any written work which is in public domain is known with its author as originator until and unless mentioned otherwise. "A general principle underlying ethical writing is the notion that the written work of an author in any form including manuscript, a research paper, a grant proposal etc represents an implicit contract between the author and its readers. The implicit contract is the reader assumes that the author is the sole originator of

the written work. The breach of this understanding or contract falls in the domain of plagiarism" (1). An ethical writing is clear, accurate, fair and honest" ((2). If the author is borrowing any text or ideas from others the same will be clearly identified and mentioned as such by established conventions. It is also understood that the ideas conveyed in the scientific writing are accurately represented to the best of the author's abilities.

Three major scientific misconducts

The three major types of scientific misconduct are plagiarism, falsification and fabrication (3). Out of these plagiarism is most widely practiced but is easily detectable. At present there are number of software which can detect the extent of plagiarism. As a result most often, plagiarists have been identified, demoted, dismissed from their schools, from their jobs, and their degrees and honors have been rescinded as a result of their misdeeds especially in developed countries (4). A number of such cases have been investigated by SSV and the findings sent to the concerned organization for taking action if the allegations were found true. These are on the website of SSV ((4). In some cases punishments were given by the concerned organizations to the guilty persons. For example;

- An Ex –vice chancellor of Kumaon Univ. (2002) was found to have plagiarized several published research papers of others, as also of publishing same/similar papers in more than one journal. On the initiative of SSV and some other agencies a committee was constituted by the Governor of Utterakhand which found him guilty and he was removed

- Recently a person was selected for the post of Assistant professor at the newly started IIT, Rajasthan. The SSV came to know that his several papers are plagiarized. The president SSV wrote about it to the Director IIT, Rajasthan. There after his appointment was withdrawn.

Plagiarism

As stated before, this article deals with different aspect of plagiarism. The word plagiarism is traditionally defined as the taking of words, images, ideas, etc. from an author and presenting them as one's own. Its synonyms are kidnapping of words, kidnapping of ideas, fraud, and literary theft etc. (1). A more refined definition may be as **t**aking over the ideas, methods, or written

words of another person, without acknowledgment and with the intention ***that they be taken as the work of the deceiver*****." (6).** With increasing cases, both in terms of frequency and extent, of plagiarism a more strict view was presented by Federal Office of Science and Technology, USA by expanding their definition in 1999 as;

"Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit, including those obtained through confidential review of others' research proposals and manuscripts".

Several efforts have been made to develop teaching material to educate young researchers and aspiring scientists, who are ignorant of what constitutes plagiarism in scientific writing, in the ethical conduct of research.. One such article was prepared by Miguel Roig, PhD, titled "Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing (1).The office of research Integrity (ORI) has sponsored preparation of the article by Miguel Roig along with many other such instructional material to help students and practicing scientists, identify and curb such practices by developing awareness in this regard. The article presents a vivid view of do's and don'ts and most of the material that is presented below have been taken from this article.

Two major types of plagiarism in scholarly writing:

The two major types of plagiarism in scientific writing are plagiarism of ideas and plagiarism of text. Both forms are dangerous to science and need to be curbed. It would be appropriate to understand these two types of plagiarism, in detail.

1. Plagiarism of ideas

This is an era of competition and there is a race to claim good and original works. This sometimes leads to stealing ideas of some scholar or a laboratory to avoid **"just too late**". This childish approach of "**me first**" by adopting wrong means is root cause of this kind of plagiarism which is not very uncommon in scientific pursuit. It may be defined as

Appropriating an idea (e.g., an explanation, a theory, a conclusion, a hypothesis, a metaphor) in whole or in part, or with superficial modifications without giving credit to its originator. (1).

This act also tantamount to breach of contract between the writer and the reader as mentioned in the definition of plagiarism. In fact, ethical writing demands ideas, data, and conclusions that are borrowed from others and used as the foundation of one's own contributions to the literature, must be properly acknowledged either in form of a footnote or a reference citation.

2. Plagiarism of text

With advent of modern tools particularly computers and internet it has become easy to by "copy and paste". This is very common in young scholars including school students. The plagiarism of text may be defined as
"Copying a portion of text from another source without giving credit to its author and without enclosing the borrowed text in quotation marks." **(1).**
When it comes to using others' word-for-word (verbatim) text in our writing the accepted rule is **"to enclose that information in quotations and to indicate the specific source of that text."** (1). Although the evidence indicates that most authors, including college students, are aware of rules regarding the use of quotation marks, plagiarism of text is probably the most common type of plagiarism. There is clear guideline in this regard that any verbatim text taken from another author must be enclosed in quotation marks.

Some authors clandestinely do some superfluous modifications and present the article as its originator. This amounts to scientific misconduct. Thus the stiffer rule is that "c***opying a portion of text from one or more sources, inserting and/or deleting some of the words, or substituting some words with synonyms, but never giving credit to its author nor enclosing the verbatim material in quotation marks constitutes plagiarism of text with more serious offence because it gives no scope for ignorance in which many of the first offenders take shelters"*** (1)
So the guideline in this regards is loud and clear.
"We must always acknowledge every source that we use in our writing; whether we paraphrase it, summarize it, or enclose it quotations". (1).

Inappropriate paraphrasing

Paraphrasing is another misconduct noticed in scientific writing by those who are smart enough in twisting the language and are rich with word power. The paraphrasing can be defined as;

"Taking portions of text from one or more sources, without crediting the author/s, but only changing one or two words or simply rearranging the order, voice (i.e., active vs. passive) and/or tense of the sentences". (1).

Unlike a summary, which results in a substantially shorter textual product, a paraphrase usually results in writing of equivalent textual length as the original, but, of course, with a different words and, ideally, different sentence structure.

There exists clear cut guideline in this regard also

"**Whether we are paraphrasing or summarizing we must always identify the source of our information. Please note, too, that simply changing a few words here and there, or changing the order of a few words in a sentence or paragraph, is still plagiarism**." (1).

The commonly used methodology is what is given by Office of Research **integrity (ORI), USA**

"Office of Research integrity (ORI) generally does not pursue the limited use of identical or nearly identical phrases which describe a commonly-used methodology or previous research because ORI does not consider such use as substantially misleading to the reader." (1).

Thus, we may conclude based on above said discussion that "**a responsible writer has an ethical responsibility to readers, and to the author(s) from whom she/he is borrowing, to respect others' ideas and words, to credit those from whom we borrow, and whenever possible, to use one's own words when paraphrasing"**(1)**.**

However, reporting of common knowledge does not come in the purview of unethical paraphrasing. In this regard the guideline is **"when in doubt as to whether a concept or fact is common knowledge, provide a citation."**

Self Plagiarism

This is one of the most common forms of plagiarism done often by ignorance. There is misbelieve among many authors that the material prepared by them might be used any number of times without giving its reference. As a result many young authors commit this mistake. The self-plagiarism may be described as;

- In writing self-plagiarism occurs when authors reuse their own previously written work or data in a 'new' written product without letting the reader know that this material has appeared elsewhere. (1).

- **"…** the essence of self plagiarism is [that] the author attempts to deceive the reader". (7)

Although in scholarly and scientific writing, under some situation, some form of reuse of text is acceptable but in many other situations reuse of text and / or data violates the ethical sprit of scientific writing. But keeping in view the implicit contract between the author and the reader whereby the reader assumes, unless otherwise noted, that the material is new, original and accurate to the author's ability, any violation of this contract comes under the arena of the self plagiarism**.**

Four Other Major Problems

There are three other major problems associated with plagiarism which are important for the scientists. All these problems fall under misconduct.

1. Redundant and duplicate publication

It is the publication of what is essentially the same paper in more than one journal, but without any indication that the paper has been published elsewhere

2. Salami-slicing

It is the partitioning of a large study which should have been reported in a single paper into smaller published studies. Salami Slicing (i.e., data fragmentation) although often associated with redundant publication, the segmenting of a large study into two or more publications is somewhat different than reporting exactly the same data in two publications, but it is a similarly unacceptable scientific practice. A related malpractice known as data augmentation occurs when a researcher publishes a study and subsequently collects additional data, which typically end up strengthening the original effect, and publishes the combined results as a new study. The reader is misled into believing that the data from the new study is derived from a sample that is different than the one from which the initial data were derived. So the guidelines are as given below (7).

"If the results of a single complex study are best presented as a 'cohesive' single whole, they should not be partitioned into individual papers."

If there is any doubt as to whether a paper submitted for publication represents fragmented data, authors should enclose other papers (published or unpublished) that might be part of the paper under consideration (8). Similarly old data that has been merely augmented with additional data points and that is subsequently presented as a new study is an equally serious ethical breach. As some instances of plagiarism and self-plagiarism (e.g., redundant publication) have the potential for violating copyright law, the rules of concept of copyright must be understood by the authors.

3. Copyright infringement

It is basically violation of copyright. Here the guideline is "because some instances of plagiarism, self plagiarism, and even some writing practices that might otherwise be acceptable (e.g., extensive paraphrasing or quoting of key elements of a book) can constitute copyright infringement, authors are strongly encouraged to become familiar with basic elements of copyright law" (1). Similarly many authors do not understand the implications of signing the copyright release form. In essence, this transfers ownership of the paper and all of its contents from the author to the publisher. Subsequent papers written by the same author therefore must be careful not to reproduce in any way material that has previously been published, even if it is written by them" (1).

Open Access is solution

An increasing number of journals now allow the author to maintain ownership of their work, but both entities sign an agreement specifying the journals' right to publish and re-use the author's material. In the case of "Open Access" journals (freely available to the public without expectation of payment), the author agrees to allow for the free dissemination of his/her works without prior permission. A lot of efforts have gone in convincing the authors and publishers for Open Access. It is a separate subject to be debated and discussed. But as most of research worldwide is done by investing public money, it would be appropriate to adopt Open Access Concept. This would help solving many problems with one tool.

About Society for Scientific Values

The Society for Scientific values was formed in 1986 by 107 reputed scientists of high integrity from all over India. At present it has 367 members. Its main objectives are;

1. To promote objectivity, integrity and ethical values in pursuit of scientific research, education and management, and

2. To discourage the unethical acts in these areas.

The requirements of becoming its member are:

1. He (or she wherever applicable) should have allowed his name to appear as an author in only those publications in which he was actively involved, e.g. in data collection, theoretical formulations, design and construction of apparatus, field trips, statistical analysis, and interpretation of the results, as distinct from administrative support and providing funds or facilities.

2. He should never have plagiarized, or made false claims or indulged in or encouraged any kind of unethical or dishonest activity in science.

3. He should whole-heartedly support decisions and actions to be taken collectively by the Society after such decisions and actions had approved by him.

4. Non-scientists who have promoted ethics in their profession can also become member of the Society

It may be noted that requirement No.1 for becoming member of the Society has laid down the requirement of becoming author in research papers. It is unethical to become author of a paper without meeting this requirement.

A sentence from the preamble of SSV is as under;

“For this it is of utmost importance to promote by personal and collective efforts, the ethics and norms of science not only for the progress of science and technology in the country but also for national character”. At present

there is a sharp decline in the moral values in the country. There is overall decline in national character. All the right thinking people want the situation to change. But the question is how? The scientists, whose profession is search of truth, are expected to take a lead and contribute their bit for raising national character by punishing wrong doers in scientific and technological research and management. The society for scientific values is relentlessly working in this direction with its very little resources by exposing fraud and misconduct in science and technology and urging the concerned organization to take strict disciplinary action against persons who indulge in such acts. Along with pleading for punishment of unethical acts, the Society has taken up a program for educating research scholars and young scientists about what constitute misconduct in scientific and technological research, education and management by organizing lectures and discussions at different places in the country. The society has prepared materials for such lectures and discussions. The present article is one such material.

Acknowledgement

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Falsification and fabrication- Ways to Deal with Them

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Introduction

Profession of science is quite different from all other professions in the sense that it is the search of objective truth free from personal opinion of any person how so high position he may be holding in the profession. Because of this a true scientific community is different from other communities in their adherence to truth. "Analysing the characteristics of scientific community Jacob Bronowski has stated that by worldly standards of public life, members of the scientific community are oddly virtuous in their work. They do not make wild claims, they do not cheat. They do not try to persuade at any cost, they appeal neither to prejudice nor to authority, they are often frank about their ignorance, their disputes are fairly decorous, they do not confuse what is being argued with race, politics, sex or age; they listen patently to the young and to the old. Individually, some scientists, no doubt, have human weaknesses. But the body of scientists is trained to avoid and organized to resist every form of persuasion but the fact" (1).

Because of the special nature of scientific community, "researchers trust that their colleagues have gathered data correctly, have treated it with appropriate analytical and statistical techniques and have reported their results accurately giving due credit to the work of other researchers in the area. This is essential for the scientific progress. Anyone who breaches this trust puts his scientific career at risk and undermines the foundation of science and impedes scientific progress. The actions that cause the breach of this trust are collectively called "scientific misconduct" (2). These acts are falsification, fabrication and plagiarism in performing or reviewing research or in reporting research results. These three types of misconducts are defined as (2);

1. Falsification is "manipulating research materials or processes or equipment or omitting data or results such that the research is not accurately represented in the research record."
2. Fabrication is "making up data or results."
3. Plagiarism is "the appropriation of another person's ideas, processes, results, or words without giving appropriate credit."

"When researchers intentionally deceive their colleagues by falsifying information, fabricating research results or using other's words and ideas without giving credit, then they are violating fundamental research standards and basic societal values. These actions are seen as worst violation of scientific standards because they undermine the trust on which science based" (2).

This article deals with the two major misconduct namely, falsification and fabrication, and the ways to eliminate or minimize them. Unlike plagiarism, falsification and fabrication introduce spurious results in the research records. It may cause serious damage to individual who does it, to the institution where it is done and to the area of research in which such misconduct is committed. Fabrication and Falsification of results is distinct from genuine mistakes. "Genuine mistakes can occur if suitable precautions are not taken, while fabrication and falsification of results is done deliberately, especially, in cases where experiments cannot be easily replicated. It is the intention and knowledge of the consequences that distinguishes it from the genuine mistakes. Such frauds are detected only when another scientist starts the same line of research for obtaining more results and as a first step fails to repeat the fraudulent experiment"(4). Or it is exposed by someone working in the same laboratory where fraud was committed by reporting it to concerned authority.

Ways to Minimize Scientific Misconduct

There are two ways to eliminate and minimize scientific misconduct. First and the best way is to strictly follow scientific values in research and publication, and the second way is of punishment to those who violate scientific values in their research and publication. The primary objective of this article is to inform the young scientists and students of science about different scientific values, and the need to fallow them in their scientific work. A few examples of punishment that have been meted out to those who indulged in fabrication and falsification have also been described.

Follow Scientific Values

The Society of Scientific Values was formed in 1986 by many top scientists of high integrity to promote scientific values in the pursuit of science and discourage any kind of its violation. The Society had organized in 1989 a seminar on "Scientific Values and Excellence in Science". In this seminar a comprehensive account of scientific values were presented by Prof.

J.N.Kapur in the form of code of conduct for scientists and for science students (3). The same are reproduced below.

Code of Conduct for Scientists:

1. I believe that science is 'relentless pursuit of truth' and to realize this noble goal, I shall always employ noble means and no others.
2. I shall pursue all values of science like originality, creativity, impartiality, fairness, objectivity, integrity, excitement and passion for new knowledge, and love for truth. I shall observe these values, not only in my scientific work, but also in all my actions, both in letter and in spirit.
3. I shall never falsify or fabricate results of my experiments and shall also see, to the best of my ability, that neither my students nor colleagues do so. I shall never make undue claims for my work. Under no conditions shall I claim any other scientist's work as my own.
4. When I conduct examinations, either for theory or practical, I shall be completely fair and impartial without any exception, and I shall refuse to be swayed by any pressures, whatever the cost may be.
5. I shall conduct examinations in only those topics in which I am fully competent and in no others. Similarly I shall examine thesis in only those subjects in which I have sufficient up-to-date knowledge. I shall examine every answer paper, research paper and every thesis with the greatest care. I shall not recommend the award of a Ph.D. degree unless I am convinced that the thesis deserves the degree.
6. I shall give due credit to all my students and colleagues who contribute to a research paper. I shall never claim to be an author of a paper to which I have not made a substantial scientific contribution.
7. I shall award all scholarships, fellowships, projects, prizes, faculty positions, scientist- positions, solely on scientific

merits of candidates and projects. I shall never yield to political or social pressures or be swayed by considerations of caste, creed regionalism etc. I shall myself never make other-than-scientific recommendations and shall refuse to listen to non-scientific recommendations. I shall always try to create a climate in which making non-scientific recommendations are looked down upon as a scientific crime.

8. I shall promote quality in science by all means at my disposal.
9. I shall promote scientific temper, scientific culture and scientific scholarship in society. I shall work for the promotion of the highest scientific and moral values in society.
10. I shall draw my inspiration from and give my respect to only dedicated and devoted scientists who pursue highest scientific values and not to those who may be in positions of power but do not follow the highest moral values in their work.

Code of Conduct for Science Students

1. I shall always be curious and inquisitive about all natural phenomena and shall try to find the truth about these phenomena by careful observation, experiments, and logical thinking.
2. I shall never falsify or fabricate my experimental results or copy the observations of others because these actions are against the spirit of science.
3. I shall faithfully record in my notebook only the results of experiments conducted by me since this is what is expected of every student of science.
4. Like every scientist, I shall always be guided by facts, logic and reasoning and never by superstitions or by prejudiced or preconceived notions.
5. I shall never use unfair means in any examination under any circumstances, since all unfair practices are anti-science.

6. I shall follow in all my actions the great scientific values of objectivity, creativity, originality, and desire to know and desire to follow the truth wherever it leads us.
7. I shall aspire for the highest excellence in science. For achieving this noble objective, I shall use only noble means and no others.

Punishment for Violating Scientific Values

What type of punishment should be meted out to those who violate scientific values keeping in mind the special characteristics of science and scientific community? In a seminar organized by the Society for Scientific Values on "Scientific Misconduct and Disciplinary Action" in 1994, Prof. A.R. Verma presented an answer to this question (4). He said "let us compare some examples of item (3) of Professor Kapur's Code of Conduct for Scientists, which is "I shall never falsify or fabricate results of my experiments and shall also see, to the best of my ability, that neither my students nor colleagues do so. I shall never make undue claims for my work. Under no conditions shall I claim any other scientist's work as my own", with similar situations of everyday public life as defined in Indian Penal Code (IPC). Take for example 'Cooking of results' (fabrication and falsification). It is comparable to 'furnishing, giving or fabricating false evidence (Sec. 177), and 'forgery' (Sec. 463) which is 'making a false document with intent to commit fraud and cheating (Sec. 415) which is 'deceiving any person fraudulently or dishonestly'. Plagiarism is stealing other scientists' work and is similar to 'theft' (Sec. 378) which is defined as 'taking dishonestly any movable property of a person without that person's consent'. The only difference in scientific case is that it is not movable property but 'intellectual property'. False authorship is like false claim to ownership. Tall claims amount to misleading people and so on. One can go on enumerating misconduct in science and comparing with everyday life situations. However, for dealing with misconduct and crime in everyday life, there is an established procedure which is laid down in law. There is an established authority that can try and pass a sentence.

It is interesting to note the punishments laid down in the I.P.C. relevant part of Section 177 reads as follows:
"Whoever… furnishes as true information on the subject which he knows or has reason to believe to be false, shall be punished with simple imprisonment for a term which may extend to six months or with a fine which may extend to one thousand rupees or with both."

Similarly, for forgery Section 465 lays down imprisonment up to one year and or fine; for theft Section 379 lays down imprisonment up to 3 years" (4).

A scientist commits scientific misconduct due to his greed for getting undue degree (PhD), appointment, award, high position and power. Most of such misconduct are detected without much delay However, some persons succeed in deceiving for long (but not always, they are exposed in due course of time). Such persons cause a lot of damage to the growth of science in their area of work, and the environment of scientific research in the organization where they hold high position. Anyone who commits scientific misconduct should be punished. Several scientists especially in developed countries have been punished for it in the past. A few examples of it are briefly described below.

Three Cases from Developed Counties

1. **Jailed for Fraud in Research**-----Eric Poehlman, a permanent faculty member at the University of Vermont, USA oversaw a lab where nearly a dozen students and postdoctoral researchers carried out his projects. His research earned him recognition among his peers and invitations to speak at conferences around the world. And he made nearly $140,000, one of the top salaries at the University of Vermont. **All of that began to change, when DeNino, joined Poehlman lab as technician.**

Poehlman was looking into how fat levels in the blood change with age. DeNinos' task was to compare the levels of lipids, or fats, in two sets of blood samples taken several years apart from a large group of patients. As the patients aged, Poehlman expected, the data would show an increase in low-density lipoprotein (LDL), which deposits cholesterol in arteries, and a decrease in high-density lipoprotein (HDL), which carries it to the liver, where it can be broken down. Poehlman's hypothesis was not controversial; the idea that lipid levels worsen with age was supported by decades of circumstantial evidence. Poehlman expected to contribute to this body of work by demonstrating the change unequivocally in a clinical study of actual patients over time. But when DeNino ran his first analysis, the data did not support the premise.

When Poehlman saw the unexpected results, he took the electronic file home with him. The following week, he returned the database to DeNino, explained that he had corrected some mistaken entries and asked DeNino to re-run the statistical analysis. Now the trend was clear: HDL appeared to

decrease markedly over time, while LDL increased, exactly as they had hypothesised.
Although DeNino trusted his boss implicitly, the change was too great to be explained by a handful of improperly entered numbers, which was all Poehlman claimed to have fixed. DeNino pulled up the original figures and compared them with the ones Poehlman had just given him. In the initial spreadsheet, many patients showed an increase in HDL from the first visit to the second. In the revised sheet, all patients showed a decrease. Astonished, DeNino read through the data again. Sure enough, the only numbers which hadn't been changed were the ones supported his hypothesis (this is an example of falsification of data to support the hypothesis).

Confused by discrepancy between data sets, DeNino went back to Poehlman and asked to see the patient file. Poehlman brushed him off which created suspicion in the mind of DeNino. He consulted a scientist who had worked with Poehlman in resent past who advised him to proceed cautiously and to first become sure that Poehlman has falsified data. DeNino spent several evenings combing through hundreds of patients records and found worst form of not only falsification but out right fabrication. He brought it to the notice of concerned authorities of the university confidentially. The subsequent investigation- a collaboration among the University of Vermont, the Office of Research Integrity (which is within the Department of Health and Human Services) and the United States Department of Justice- uncovered fraudulent research that stretched back through almost half of Poehlman's career. **The revelations led to the retraction or correction of 10 scientific papers, and Poehlman was banned forever from receiving public research money and was sentenced for one year one day imprisonment**. A detail account of it is published in Society for Scientific Values, News and Views, Vol.5 No.1 ,pp 23-28, 2007. It is on the website of the Society, www.scientificvalues.org

2. Dismissed for Fabrication-- "Beginning in 1998, a series of remarkable papers, published in Nature and Science attracted great attention within the condensed matter physics community. The papers, based largely on work done at Bell Laboratories, described methods that could create carbon-based materials with long-sought properties, including superconductivity and molecular level switching. However, when other material scientists sought to reproduce or extend the results, they were unsuccessful. Suspicion quickly fell on a young researcher named Jan Hendrik Schon, who had helped create the materials, had made the physical measurements on them, and was a co-author on all the papers. Bell Laboratories convened a committee of five

outside researchers to examine the results published in 25 papers. The committee found that Schon had engaged in fabrication in at least 16 of the 25 papers. **Schon was fired from Bell Laboratories (2).**

3. Dismissed for Fabrication-- In August 2005, a team at Seoul National University led by Hwang Woo-Suk reported in the pages of *Nature* the cloning of a dog, long considered to be much too complex to achieve. The research team had been working in parallel on a project to create a stem cell line from human embryos which was reported first in papers in *Science* in 2004 and 2005, stunning the scientific community worldwide.

Within weeks of the second paper appearing in print, skepticism arose about the claims made in the paper. An investigation into the research revealed invalidity of the claimed data. By January 2006, the university's investigative team had determined that the **papers were largely fraudulent, had to be withdrawn, and Hwang was prosecuted for the misuse of research funds.**

Birth of the Society for Scientific Values

Scientific misconduct of various types are not unknown in any country involved in scientific research. India is no exception. Some serious cases of misconduct by senior scientists in Indian scientific / academic institutions led several prominent scientists and engineers of the country to set up a Society for Scientific Values (SSV) during 1986 to nurture, culture and monitor ethical values among knowledge workers. The first prominent and serious case of scientific misconduct handled by the Society is the one which attracted international attention. A Professor and Head of the of Department of Geology, Chandigarh University, Punjab published a number of papers during 1980's on Himalayan Geology along with some top geologists of the world in prestigious international journals. He used to visit them with some fossil samples claimed to have been collected from that region of Himalayas which were not accessible to foreigners. He used to show them the samples and propose collaborative studies. They used to agree because of the opportunity to study rare fossil samples. The samples were analyzed in their laboratories and the results were published jointly with him. However, the findings of these papers contradicted the known geology of Himalaya. A geologist from Australia brought out this fact in his papers published in Nature & Science in 1989 and showed that the sample claimed to have been collected from Himalayas were actually not from Himalayas. The Indian geologist vehemently denied it arguing, like before in the case of agricultural scientists, that a third world scientist is being maligned by the first world scientists.

The Society for Scientific Values (SSV) took the responsibility to resolve the issue .The founder President of the Society, Dr. A.S. Paintal, despite his advancing age, offered to lead a team of well-known Indian geologists along with the concerned Punjab University geologist for collecting the fossils samples from the claimed region. In the beginning he had agreed to go with the team but on the day the team was to leave, he backed out saying that he has developed heart problem. However, the team went to that place from where he had claimed to have collected fossils samples. The team collected the fossil samples from there. The samples were analyzed under the supervision of the team. The findings of the analysis did not at all agree with the results published by the Indian geologist along with some top geologists of the world. It had put the reputation of those top scientists in jeopardy. However, their reputation was saved by the work of SSV which proved that it was a case of very serious breach of trust by the Punjab University geologist. The then Vice-Chancellor of Punjab University, was a man of high Integrity. He wanted to dismiss the guilty geologist but did not get the required Senate majority for it because of political manipulations.

Despite the sustained efforts of SSV over a long period to establish and expose scientific misconduct by senior scientists of the country, no demonstrative action was taken by the concerned authorities. However there is no need to despair, the SSV since its formation in 1986 has been speedily enquiring into the allegation of scientific misconduct against scientists and technologists, and sending its findings to concerned organization for taking appropriate disciplinary action if the allegation is found true. Some head of the organizations that are known for high integrity did take disciplinary action against scientist found guilty of scientific misconduct by SSV. The society has worked out the details of the actions that should be taken to effectively deal with scientific misconduct. The details of these actions are the recommendation of the seminar organized by the SSV on “Scientific Misconduct and Disciplinary Action” in 1994.

Recommendations of the Seminar

1. Since there are large number of universities and research institutions in India, it was suggested that each organization must have an Ethics Committee of its own to look into any complaint scientific misconduct. The enquiry conducted by them should not be secretive. It should follow transparent procedures. In case, a prima facie case is established, the matter

should be referred to for a formal enquiry. The enquiry could be conducted by them or entrusted to the *Society for Scientific Values.* Either the organization itself or the Society may form a committee of scientists, well known for their impartiality. Their report should be made public and appropriate disciplinary action must be taken by the concerned organization against the person found guilty of scientific misconduct.

The concerned scientific organizations should inform the *Society for Scientific Values*; scientific establishments, academies and Government bodies about the action taken by them. This information should be published in scientific journals and other publications such as University News.

2. Scientific academies/societies, organizations, Government establishments should take the following action against guilty scientists:

a) Science academies and societies should withdraw fellowships/memberships granted to such scientists;
b) Academic degrees, awards and prizes based on fraudulent work should be withdrawn;
c) Scientific journals should take note of such cases and take appropriate action such as refusal of publication of papers authored by such scientists;
d) Such scientists should not be recognized and should even be derecognized as supervisors of theses and should not be appointed as thesis examiners;
e) Such persons should not be invited to present papers and chair sessions in scientific seminars, symposia and conferences; and
f) Scientific community should boycott an institution which does not take required action against its staff found guilty of misconduct in science.

3. Various government funding agencies and University Grants Commission responsible for giving grants should ensure that the organization being given the grant has a transparent mechanism to look into and for investigating cases of scientific misconduct. In order to make the above recommendation effective, all grant giving agencies should include the following in the list of conditions for sanctioning the grant:

> "This grant is released to you on the clear understanding that no scientific misconduct will be committed by you or your collaborators.

Should an allegation of scientific misconduct be made against you and established after proper enquiry, the grant shall stand terminated and proper action which may even include termination of services of the scientists concerned be taken."

4. It should be incumbent on each and every scientist to keep the record of the work done by him/her/them to show the raw data collected in the form of notes, chart paper, computer or tape records, material from field trips etc. so that in case of need, they can be scrutinized at any stage if an allegation of scientific misconduct is made against the scientist, indeed, such records should be property of the institution and should be maintained with care.

5.In case of large projects (say Rs. Fifty lakhs and above which may be determined by the grant giving agency), the final project report which may include the objective envisaged to be achieved, the results obtained, deficiencies, (if any, together with the reasons thereof) recorded together with the referees comments (without their names) should be published and made public.

6. In case of Ph. D/D. Sc degrees awarded, it should be made compulsory for the universities to attach a certificate with the thesis showing the names of the examiners who examined and approved the thesis for the award of degree.

7. A copy of all the approved theses should be made available by the UGC at a central place where anyone can get a copy on payment.

Misconduct related to science and technology is of two types.

1. Misconduct in scientific research and publication called scientific misconduct.

2. Misconduct in management of scientific research, development and education.

The first type of misconduct has been dealt with in the present article. SSV has been dealing with this kind of misconduct. The second type of misconduct is wrong appointments, wrong awards and recognitions, wrong project funding. Second type of misconduct has been causing greater damage to the growth of science and technology in the country but nothing has been done to deal with it. It is a serious form of intellectual corruption. Being intellectual in nature it can't be eliminated by detail administrative

procedures and punishment. But it can be eliminated/ minimize quit effectively by strictly following the code of conduct for the scientists, and ensuring that only persons of high integrity are appointed on management positions. They need not be top scientists. Top scientists should be provided all the require facilities by the managers to work in their lab. The scientific community as whole including PhD students and young scientists must launch an action plan to ensure the implementation of various suggestions made in this article for improving the quality scientific and technological research and education in the country.

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Environmental Ethics

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Introduction

The Oxford dictionary defines Ethics as the Science of Morals. This implies that ethics has to deal with socially acceptable conduct. Bertrand Russell[1] elaborates that "ethics differs from science in the fact that its fundamental data are feelings and emotions, not percepts". He concludes that "we are thus led to good or bad rather than right or wrong as the fundamental concepts of ethics"

From another point of view, ethics can be considered as a part of philosophy. From historical times, the urge to be "good" has controlled human behavior and has set the framework for a righteous life. According to Satyanarayana[2] the pursuit of "moksha" or liberation in Hindu philosophy is an ethical concept

In this article, focus is on the importance of ethics in scientific practice, discussion of the role of scientists in environmental issues and finally combining the two to describe Environmental Ethics along with selected case histories.

Ethics in Science

In an ideal situation, scientists are seekers of truth. The bulk of their effort is meant to find ways to convert a Hypothesis into a Law. On the other hand, ethical questions are raised when the products of scientific discoveries are utilized by society at large. In spite of the fact that all scientific investigations are initiated with the aim of benefiting the society, later distortions and misuse are commonplace. Several years ago, Russell[1], while expressing his concern about the misuse of atomic energy for military purpose, pointed out that there were "other less spectacular ways of producing disaster" He cited the example of bacteriological warfare where scientific techniques could be used to poison the soil or crops of an enemy territory.

Much of the present-day concern about ethics in science has stemmed from scientific misconduct like plagiarism, duplicate or recycled publication, quality and integrity of data[3]. In expecting scientists to be morally upright, we assume that compared with other professionals they are more conscious of ethical values. In fact, scientific values are supposed to inculcate "high levels of integrity and honesty, wisdom, loyalty, fairness, impartiality, trustworthiness, reliability, courage, compassion, humility, divinity, love and being not submissive observer or remaining indifferent to wrong happenings"[3]. On the other hand, Rollin[4] makes the point that science is a career. Therefore, a scientist, like other professionals, is likely to be a breadwinner and head of a household. Strong pressures to be successful and rich "provide vectors encouraging cheating or data fudging or dropping the few examples of data belying your hypothesis"[4].

The same author[4] makes the startling observation that "falsification of data begins in (the) undergraduate laboratory" In a survey of 700 students in biology and chemistry, up to 75 percent of students admitted to manipulation of data "almost always". This makes it imperative that ethical values are inculcated in all budding scientists as early as possible.

According to Whitehead[5], a scientific curriculum must have a "hard element" and a "soft element". The hard element may consist of fist-hand observations in laboratory sessions. The soft element gives the students the freedom to browse and attend descriptive lectures. With the advent of the Internet, browsing is easy but at the same fraught with the danger of plagiarism.

Environmental Science

One of the major challenges for scientists in the present century is monitoring environmental degradation. Environmental problems arise mostly because of the utilization of natural resources in a non-sustainable manner. The scientific approach is, therefore necessarily multi-disciplinary. Before the final engineering design for remedial measures is adopted, experts in physical sciences, biological sciences and medical sciences have to diagnose the problem. Environmental Impact Analysis is a compulsory step for obtaining the clearance for a new industrial unit. Even for existing industries, evaluation of the impact on air, water, soil and bio-diversity is often required.

Environmental Awareness

Two United Nations conferences – Stockholm 1972 and Rio de Janeiro 1992- are considered as turning points in world-wide efforts to contain damage to our environment. It has been realized that economic policies that destroy the environment cannot be equated with development. The common man is not fully aware of the irreversible damage to air, water, soil and biosphere which can result from the so-called modernization of our way of life. There is a vague idea that the recent increase in the frequency of natural disasters like cyclones and tsunamis is somehow related to climate change. There is an urgent need to spread awareness about the impact of greenhouse gases, industrial wastes and indiscriminate use of fertilizers on public health. It is here that our education system has a vital role to play.

Classification

It is natural that all attempts to protect the environment have the primary objective of benefit to the present and future generations of mankind. Taylor[6] classifies this as human-centred or *Anthropocentric Environmental Ethics.* A typical guideline for this approach would be "an obligation not to allow natural environment to deteriorate to such an extent that the survival and well-being of later human inhabitants of the Earth are jeopardized".

However, Taylor[6] proposes to extend the scope of Environmental Ethics to non-human inhabitants of the natural world like plants and animals. His argument is that the earth's resources should not be considered merely as commodities meant to be exploited and consumed by human beings. This extended version termed life-centred or *Biocentric Environmental Ethics* is what our present activities should aim for. "Our duties toward the Earth's non-human forms of life are grounded on their status as entities possessing inherent worth".

Environmental Injustice

In spite all good intentions, some of the developmental activities undertaken today may have adverse impact on the future generation. It is very difficult to avoid a conflict between exploitation of natural resources and preservation of the natural habitat. Attfield[7] has discussed a disturbing fact which has emerged in the later part of the twentieth century. After surveying the geopolitical scene, he concludes that the economically backward groups within a country and across international boundaries are often subjected

preferential ecological damage. Some well-known examples are poor sanitation around slum clusters, dumping of toxic waste in third-world countries and the widespread arsenic contamination of groundwater in Bangladesh.

These activities have been classified as *Environmental Injustice* because the vulnerable population is not in a position to protect them from powerful lobbies[8]. When elements of racial discrimination are detected in these malpractices, some authors go to the extent of labeling them as *Environmental Racism*.

Human Impact on the Environment

A cursory look at the living condition of the rural and urban poor is sufficient to realize the appalling state of health and sanitation. Recent statistics from India[9] indicate that among our urban population, about 90 percent have access to safe drinking water and 70 percent have toilet facility in the house. In contrast, the numbers for rural population are 73 percent and 20 percent respectively, In other words, a majority of people in our villages are deprived of the two essential privileges of drinking water and sanitation.

The common criterion for the harmful effects of environmental pollution is public health. A major source of pathogenic micro-organisms and toxic metals is waste water from domestic and industrial use. In addition, increasing use of chemical fertilizers and pesticides in the agricultural sector has led to health hazards from nitrate, phosphate and a variety of organic chemicals. These pollutants are usually discharged through soil profiles into water bodies. As a result, the land and water resources around urban clusters have been permanently damaged.

The recent controversy over hydel projects in our major river basins had its origin in the concept of Environmental Flow[10]. This concept requires a compromise between construction of dams and sufficient discharge downstream so that the local ecosystem and its dependent species are protected.

Another major environmental issue which emerged in the last decade was the strong evidence for climate change. Burning of fossil fuels has been a disastrous misadventure on our part. Continuous addition of Green House Gases to the atmosphere has resulted in retention of terrestrial Infra-Red emission. This has caused an increase in the average surface temperature of

the earth. Most climate scientists agree that a rise by more than 2°C above the pre-industrial level is a threshold after which there may be irreversible changes in the global weather. Glacial meltdown, rise in sea level, alterations in rainfall and wind current patterns would increase the frequency of floods, cyclones and other natural hazards. The impact on food production, ecosystems and bio-diversity would expose a large population to severe Water Stress[11].

Selected Case Histories

In this section we would recall two well-known environmental disasters – one related to water pollution and the other about release of a toxic gas from a chemical factory. To be consistent with the theme of this discussion, the focus is on violation of environmental ethics.

Arsenic in Drinking Water

Here is an example of how a well-intentioned initiative to provide safe drinking water to the rural population of Bangladesh ended up in a human tragedy. After realizing that epidemics of water-borne diseases were being caused by the traditional practice of using river and pond water, the Government switched to groundwater. In early 1990's, millions of tube-wells were sunk with financial aid from UNICEF and the World Bank. Unfortunately, the water was contaminated with arsenic. This chemical constituent manifested itself in outbreaks of skin cancer within a short period after installation of the tube-wells. Much later, in the year 2002, a survey showed that some 50 million people were drinking water that contained arsenic much above the permissible limit of 50 ppb recommended by WHO.

This was followed by an attempt to cover up this public-health crisis. In a hard-hitting editorial in the Journal *Nature*[12], it was concluded that the fear of legal liability prevented Government officials and scientists from owning responsibility. After a prolonged court case in England, and in spite of loud protests from the international community, no one was found guilty.

The scene had shifted to England because the British Geological Survey was involved in the hydro-geologic work. Although their scientists had repeatedly verified the performance of the wells, the water was not analyzed for arsenic. Their argument was that arsenic was not expected in groundwater of river sediments as found in the delta region of the Ganges and the Brahmaputra. This claim was disputed by many experts. The reason was that as early as in 1983 the School of Tropical Medicine, situated across the

border in Kolkata, had published reports on arsenic contamination of groundwater from a similar geological setup. There were two counter-arguments. One was that this finding by local scientists was not given adequate publicity in international journals and conferences. Therefore, western experts were not aware of the risk. The second was that if these experts were now declared guilty then developing countries would be deprived of much-needed western expertise!

The question that has not been answered yet is whether this was an act of negligence or a deliberate move to avoid responsibility. Had the local and foreign scientists been more vigilant in keeping track of on-going research, perhaps this disaster could have been averted. There is no doubt that precious time was lost before remedial measures were contemplated. Even now while arsenic contamination of groundwater is being reported from India, Bangladesh, Thailand and other countries, scientists and technologists continue to struggle with tentative hypotheses and pilot projects.

Toxic Gas in Bhopal's Air

Late in the night of 2nd December 1984, a cloud of Methyl Iso Cyanate (MIC) started spreading over Bhopal, Madhya Pradesh. The source was a leak in the storage tank of the Union Carbide factory which was using this chemical to manufacture pesticides. According to present estimates, this accident resulted in the death of over 20,000 people and physical harm to over 5 lakhs. The trauma and other psychological problems are still continuing. The soil and groundwater around the factory has been heavily polluted. In the year 2010 it was realized that 25 years have passed since the date of the accident. There were many reviews of the action taken in the interim period. The overall conclusion was that there has been a dismal failure in the Government and the Judiciary to protect the citizens[13].

Was this accident avoidable? To start with, it was a poor decision to select the site for the factory in a crowded locality. The method of storing large volumes of MIC in tanks was also fraught with risk. "The plant in Bhopal was the only one in the world which had MIC storage as part of its design"[13].Moreover, it has been reported that the authorities had ignored warnings from the US team and local employees about an impending disaster.

Immediately after the accident, the Management typically went into a state of denial. It was argued that because MIC breaks down in contact with water, it could not cause any serious health problems. This, in spite of instantaneous

deaths and local hospitals full of patients suffering from inhalation injury .Many others had direct effect in their eyes. To make matters worse, the Government machinery tried to suppress records collected by voluntary organizations about the number of deaths and injuries. Finally in 1989, the Supreme Court of India approved a compensation package of $470 million against the original demand of $3.3 billion. A former Supreme Court judge remarked:"Bhopal was too poor to adequately project the pathetic scene to attract compassion. After all, the dead ones were Indians and killers were rich, white corporate"[14].

During the review process in 2010, a court verdict sentenced seven high-ranking officials of Union Carbide India Limited to two years of imprisonment under charges diluted from culpable homicide to negligence[13]. The Union Government also announced some relief measures and a plan to clean up contaminated site. An interesting fact that emerged at this stage was that pollution of soil and groundwater had started as early as in 1969 when the Company began dumping its hazardous wastes within the factory premises. Therefore, this pollution was not a direct effect of the gas leak in 1984. This means that the task of detoxifying the site will be an enormous one.

Concluding Remarks

It should be apparent from the above discussion that ethical considerations are very often given a low priority in developmental projects. However, when environmental damage is inflicted on a project site, the project itself becomes self-defeating at the end. Therefore, there is an urgent need for awareness about the delicate balance between economic gain and preservation of the ecosystem. Any project would be a failure if the local population is not taken into confidence. The future generation has a significant role to play in this context. Ethical concepts have to be introduced at an early stage of our education programs.

Taking the two case histories as examples, many of the remedial measures require further research. Development of an appropriate technology for removal of arsenic from ground water and disposal of the toxic sludge from filtration setups would take a long time. Similarly, cleaning up of the Bhopal site appears to be an expensive and time-**consuming** proposition. One can only hope for an unbiased approach and an ethical framework at this stage.

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